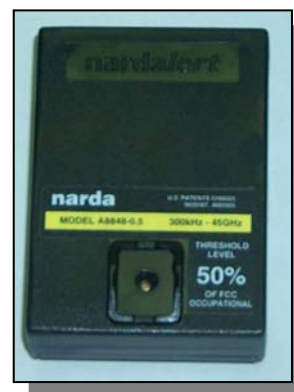


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- 2.0 Responsibilities
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- 4.0 Prerequisites
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1.0 Purpose/Scope

This procedure provides a standardized method for the operation of the Nardalert Model A8848-0.5 Electromagnetic Radiation Personal Alarm Monitor. It should be used in conjunction with the SBMS Subject Area *RF and Microwave Radiation* and IH SOP IH99150 *Radiofrequency and Microwave Measurement Principles*.

The Nardalert monitor provides a method for easy and accurate alerting of potential workplace RF exposures. This monitor is meant to be worn on the body and is used to respond with an alert upon reaching 50% of the allowable FCC 1997 Regulation Occupational/Controlled Environments for frequencies between 300 kHz and 45 GHz. It can be used as a warning device when personnel are going into areas where there may be a reason to believe, based on previous area surveys, that over exposures may occur.

2.0 Responsibilities

- 2.1 Use of the Nardalert monitor is limited to persons who act under the direction of a competent RF/Microwave hazard assessor and who have demonstrated the competency to satisfactorily understand the alarm of this monitor.

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3.0 **Definitions**

Frequency: The number of cycles completed per unit time. Unit, hertz (Hz) measures cycles per second; kHz: kilohertz; MHz: mega hertz; GHz: gigahertz.

Radio Frequency: A frequency that is used for radio transmission. Note: Although the RF spectrum is formally defined in terms of frequency from 0 to 3000 GHz for purposes of this standard, the frequency range of interest is 300 kHz to 45 GHz.

Specific Absorption Rate (SAR): the rate of energy absorbed by a unit mass (e.g., one kg or one g of tissue) of the object. The unit of measurement for the SAR is watts per kg (W/kg).

Field Levels: Radio frequency (RF) field intensities are usually measured in milliwatts per square centimeter (mW/cm²).

Occupational Exposure Limit: The maximum time weighted average (TWA) or ceiling value permitted for employee exposure, based on the lesser of the OSHA Permissible Exposure Level (PEL) or ACGIH Threshold Limit Value (TLV). OSHA does not have an RF field standard for all wavelengths. BNL has adopted the ACGIH guidelines identified in the RF/Microwave subject area.

4.0 **Prerequisites**

4.1 **Training prior to using this monitor:**

- 4.1.1 Demonstration of proper operation of the instrument to the satisfaction of the employee's supervision.
- 4.1.2 Other appropriate training for the area to be entered (check with ESH coordinator or FS Representative for the facility).
- 4.1.3 Review of the RF/Microwave subject area.

4.2 **Area Access:**

- 4.2.1 Contact the appropriate Facility Support Representative or Technician to obtain approval to enter radiological areas.
- 4.2.2 Verify with the appropriate Facility Support Representative or Technician if a Work Permit or Radiological Work Permit is needed or is in effect. If so, review and sign the permit.

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4.2.3 Use appropriate PPE for area.

5.0 Precautions

5.1 Hazard Determination:

- 5.1.1 The operation of this monitor does not cause exposure to any chemical, physical, or radiological hazards. The monitor design does not cause significant ergonomic concerns in routine use. The monitor does not generate Hazardous Waste.
- 5.1.2 By its very nature, the Nardalert monitor may be used in areas where RF levels are suspected to be present. Sources which generate RF exposure should be locked out of service whenever possible to eliminate the potential for over-exposure. All sources should be evaluated for potential exposure prior to conducting operations in the exposure area.
- 5.1.3 The primary hazard from rf/microwave is heating of the body. The eyes and genitals/reproductive organs are the most sensitive. Prolonged exposure to very high sources can result in death to the individual.
- 5.1.4 The monitor is capable of operating in fields up to 3000% of the FCC 1997 Regulation *Occupational/Controlled Environments* criteria. However it is important to know that the electronics can be burned by entry into fields above their capacity. Approach the source from a low background. However, it is important that if the monitor ceases to perform, for individuals to exit from the area till the cause of the malfunction is determined (i.e., electronics were burned out because of overexposure to a field, or some other reason).

5.2 Personal Protective Equipment:

- 5.2.1 If high fields are expected, unknown, or intermittent, the Nardalert monitor should be worn to notify the worker of exposures.
- 5.2.2 Additional PPE: Other appropriate PPE for the area being entered. Check with your ES&H Coordinator or Facility Support representative.
- 5.2.3 Besides this alarming monitor, BNL currently does not have any additional rf /microwave protective clothing at this time.

6.0 Procedure

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6.1 **Equipment:** (See photos in Attachment 9.1)

6.1.1 Monitor Body

6.1.2 Battery

6.2 Determine if the range of the source is within the range of the equipment- 300kHz to 45 GHz.

6.3 Determine if the Nardalert® is in calibration via a label on back of unit. The Calibration due date is written on the label. There is no onsite calibration check for this monitor.

6.4 **Turning on the monitor:** set power switch on the side of the monitor to “On” position.

6.5 **Testing the monitor prior to each use:**

Operating test: Set power switch to “On”. The LED exposure indicator will flash and the audible alarm will chirp about four seconds later.



Reset Test – Turn unit off for at least 10 seconds, then switch back on. The LED exposure indicator will flash and audible alarm will chirp. The monitor is fully functional and ready for use.

Refer to the Troubleshooting information section if the monitor fails any of these tests. If the monitor fails either of these two tests refer to the troubleshooting guide – Attachment 9.4.

6.6 **Signal indicators of proper operation or failure:**

	Audible	Visual
Powering up: system ok if:	2 second burst	LED flash
Low Battery at startup	Continuous Chirping	no flashing
Low Battery during running	Audible Chirp every 40 seconds	no flashing
Sensor Failure	Continuous Chirping	no flashing
High exposure Alarm	Continuous 4 Chirps per second	Continuous 1flash per second

6.7 **Warm-up:** A warm-up is not required for this monitor.

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6.8 **Operation:** After testing is complete and the unit is functional, place it on the worker. The monitor is worn on the body at chest height. The design allows the Nardalert® to respond to electromagnetic energy of any polarization that emanates from in front, side, above or below the monitor. This device does not have the ability to detect exposures from behind the wearer when the unit is in the front of the wearer.

6.8.1 The Nardalert will sound an audio alarm and illuminate the LED indicator if it detects an electromagnetic field level greater than its alarm threshold. The audio alarm will sound approximately four times per second when the field is higher than the alarm threshold.

6.8.2 The alarm will shut off once the field level falls below the alarm threshold. The LED exposure indicator will illuminate when the alarm threshold is first exceeded and will “latch on” and will continue to flash once per second. Once the audio indicator has shut off, reset the Nardalert to shut off the LED exposure indicator.



6.9 **Documenting readings:** Return monitor and original sampling form to the SHSD IH Laboratory daily or at the end of each project as agreed to by the IH Laboratory Technician. Send a copy of any hazard evaluation report written to the IH Laboratory, the employee and supervisor, ESH Coordinator, and the Occupational Medicine Clinic.

7.0 **Implementation and Training**

7.1 **Training prior to using this monitor:**

- Demonstration of proper operation of this instrument to the satisfaction of the employee's supervision prior to being the Hazard Assessor that supervises the use of this monitor.
- A record of qualification will be maintained on an equivalent of Attachment 9.3
- Personnel shall re-qualify on at least a three year basis.

8.0 **References**

8.1 Nardalert® 8846 and 8848 Series Operation and Maintenance manual. 9/99. Narda 343c Moreland Road, Hauppauge NY 11788. (631)231-1700, nardaeast@L-3com.com, www.nardamicrowave.com

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8.2 BNL SBMS Subject Area RF/Microwave

8.3 ACGIH Documentation of TLVs. American Conference of Governmental Industrial Hygienists.

9.0 Attachments

9.1 Photo of monitor and parts

9.2 Theory of Operation

9.3 Short Operating Instructions & Testing and Troubleshooting Guide

9.4 Qualification Form

10.0 Documentation

Document Development and Revision Control Tracking		
Prepared By: <i>(signature/date on file)</i> N. Bernholc 11/22/02: 07/04/04 Certified Industrial Hygienist	Reviewed By / Date: <i>(signature/date on file)</i> J. Peters 08/18/05 Certified Industrial Hygienist	Approved By / Date: <i>(signature/date on file)</i> R. Selvey 08/18/05 Industrial Hygienist Group Leader
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52.05
Facility Support Rep. / Date: <i>none</i>	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 08/18/05
ISM Review - Hazard Categorization <input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input type="checkbox"/> Desk Top Review <input checked="" type="checkbox"/> SME Review Name / Date: N. Bernholc 8/18/05	IMPLEMENTATION: Training Completed: n/a Procedure posted on Web: 08/18/05 Hard Copy files updated: 08/18/05

The only official copy is on-line at the SHSD IH Group website.
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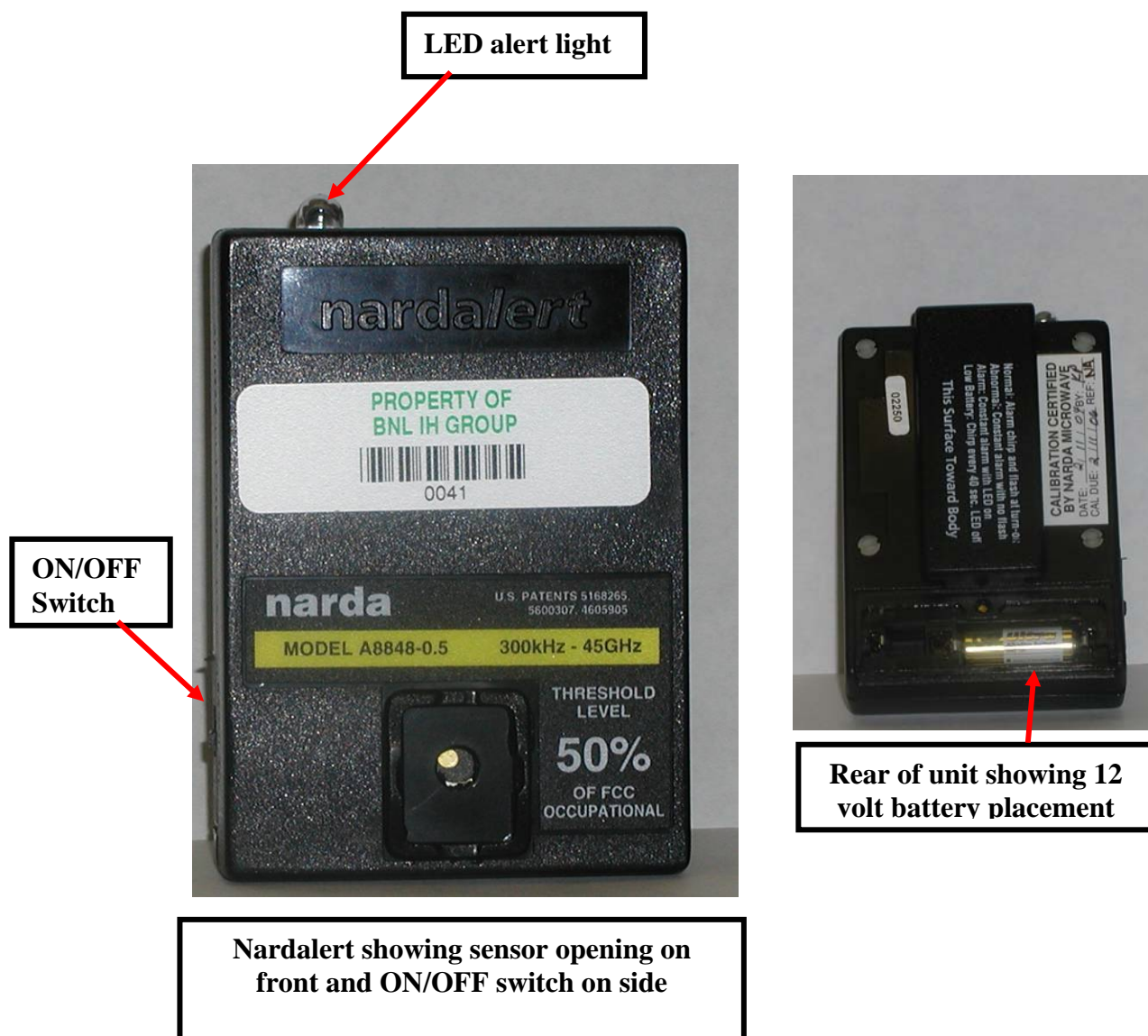
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Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above		
Section/page and Description of change: Change in 6.6 to more clearly describe the alarms. This change was based on worker input during the first training session.		
<i>R. Selvey 08/19/05</i> (signature/date on file) SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:

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Attachment 9.1 Photo of the monitor



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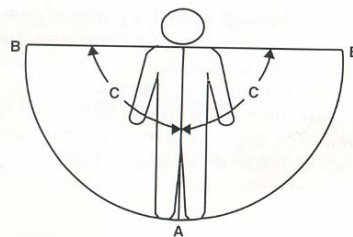
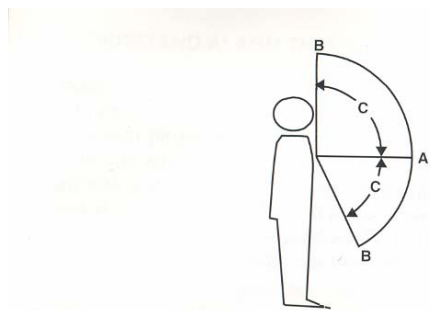
Attachment 9.2

Theory of Operation

The Nardalert Personal Alarm Monitor is a precision instrument, which incorporates two thermocouple sensors to cover a broad range of radio frequencies. There are no readings. The instrument is designed to alert the wearer that she/he is exposed to a level at or above the BNL OEL. Any time the instrument alarms, appropriate action must be taken to lower the exposure level. Taking both frequency and direction into account the Nardalert monitor activates an alarm at field strengths from 25-100% of the standard or guidance.

One of the most critical features of a non-ionizing radiation personal monitor is its ability to detect energy from sources at a wide angle to the person wearing it. Unlike ionizing radiation that passes through the body and can be detected by common field badges, non-ionizing radiation has a much lower energy level which means that it will enter the body but not readily passes through it. The detector design allows the Nardalert to respond to electromagnetic energy of any polarization that emanates from in front of the monitor, from the side, or from above or below. A monitor worn on the front of the person can not detect NIR directed at the back of the body. See diagram below for the detection angles. Therefore, a monitor worn on the front of the body cannot detect non-ionizing radiation directed at the back of the body.

The detection angle is defined at the points where the sensitivity has dropped to half (3 dB) of what it is perpendicular to the unit. For emissions from most conceivable directions, Nardalert personal monitors detect all polarizations equally, which is critical in an unknown environment – since an acute failure will not have a predictable polarization. This critical parameter is defined as the “ellipse ratio.” The physical size of the Nardalert has been optimized to maintain minimum ellipse ratio errors across its entire operating range.



NOTE: Assuming that the Nardalert is worn on the chest, points "A" define the direction to maximum rated sensitivity. The sensitivity gradually decreases to 50% at points "B." "C" are the detection angles. Consult specifications table for detection angles.

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ATTACHMENT 9.3

Short Operating Instructions

- 1.0 Verify monitor is in calibration.
- 2.0 Turn monitor on
 - 2.1 The monitor will flash and audible alarm sound within four sec.
 - 2.2 Reset instrument by turning the monitor off for at least 10 seconds, and then switch it back on.
 - 2.3 The LED exposure indicator will flash and audible alarm will chirp.
- 3.0 Place monitor at about chest height.

Alarm Indications

	Audible	Visual
Turn on Test- normal operating condition	2 second burst	LED flash- continues to flash every 40 seconds
Alarm	Continuous chirps 4 chirps per second.	Continuous LED Flashes (1 Flash per second)
Low Battery	Audible chirp every 40 seconds	-
Sensor Failure	Continuous Chirping	-

Testing and Troubleshooting Guide

Using The Monitor

The Nardalert monitor was designed to be worn on the body, typically at chest height. The detector design allows the Nardalert to respond to electromagnetic energy of any polarization that emanates from in front of the monitor, from the side, or from above or below (see Detection Angles). *This device does not have the ability to detect RF exposures from behind the wearer when the unit is on the front of the wearer.*

The Nardalert will sound an audio alarm and illuminate the LED indicator if it detects an electromagnetic field level greater than its alarm threshold. The audio alarm will sound approximately four times per second when the field level is higher than the alarm threshold. The audio alarm will shut off once the field level falls below the alarm threshold. The LED Exposure Indicator will illuminate when the alarm threshold is first exceeded and will "latch on" and will continue to flash once per second. Once the audio indicator has shut off, reset the Nardalert to shut off the LED Exposure Indicator.

Alarm Indications

The table below provides a summary of the audio and visual signals that the Nardalert will indicate under various conditions.

	Audible	Visual
Turn on Test	2 second burst	LED Flash
Alarm	Continuous chirps 4 chirps per second.	Continuous LED Flashes (1 Flash per second)
Low Battery	Audible chirp every 40 seconds	—
Sensor Failure	Continuous Chirping	—

Troubleshooting Information

The Nardalert features fail-safe operation and will not operate if the detection element is defective. The table below is a listing of potential problems and the corrective procedures for each problem.

SYMPTOM	CAUSE	REMEDY
Operating Test Failure, No Visual or Audio Alarm	Low Battery Voltage	Replace Battery
Continuous Alarm at Turn-On	1. Low Battery Voltage 2. Defective Element	1. Replace Battery 2. Return for Service
Unit "Beeps" Approx. Every 40 secs. and Exposure Indicator is Not Illuminated.	Low Battery Alarm	Replace 12V Battery
Unit Passes Operating, and Reset Tests but Does Not Alarm in RF Field	Field Level Not High Enough	Verify Field Level with Narda Survey Equipment

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Attachment 9.4

Personnel Qualification Record Form

(next page)

Non-Ionizing Radiation Protection

***Nardalert® A8848-0.5* Radio Frequency Alarm Monitor**

Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:
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1	Principles of RF Exposure: <ul style="list-style-type: none"> • Demonstrated knowledge of RF measurement and the reason for sampling. • Understands the varying methods of RF monitoring and when each is appropriate. • Can explain the range of monitor and the type of response the monitor displays. 	Unsatisfactory	Recovered	Satisfactory
2	Set up of monitor: Demonstrated how to: <ul style="list-style-type: none"> • Inspect and set up the monitor. • Operate the monitor. • Instruct the wearer of the monitors how to assess the alarms, and the proper responses and corrective actions 			
3	Documentation of Monitoring: Demonstrated knowledge of: <ul style="list-style-type: none"> • Correct notification of results to specific organizations and individuals by use of the Employee Notification form and hazard assessment report. 			

Employee: I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:
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Evaluator: I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date:
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